



## 2N60-CB

Power MOSFET

### 2A, 600V N-CHANNEL POWER MOSFET

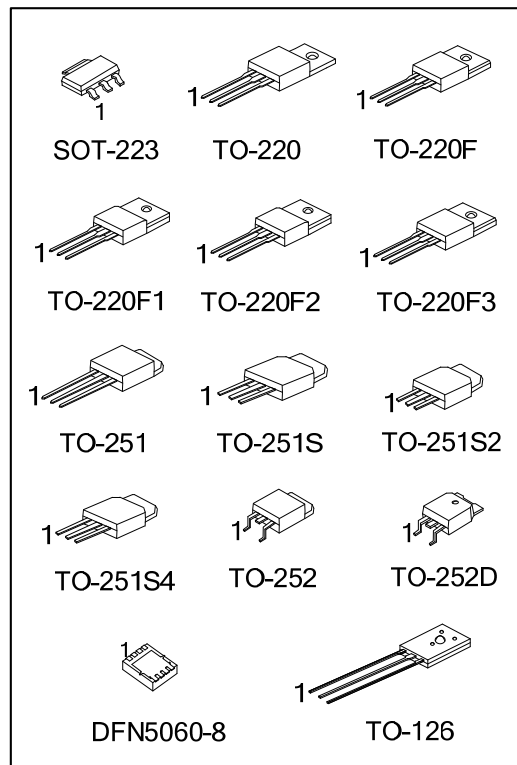
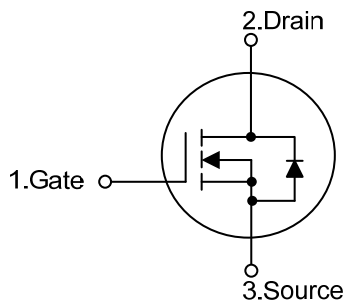
#### DESCRIPTION

The UTC **2N60-CB** is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 4.6\Omega @ V_{GS} = 10V, I_D = 1.0A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

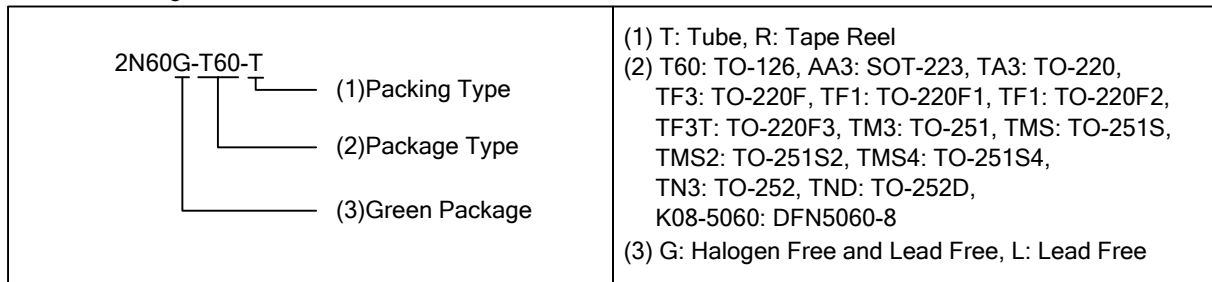
#### SYMBOL



### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment								Packing
Lead Free	Halogen Free		1	2	3	4	5	6	7	8	
2N60L-T60-T	2N60G-T60-T	TO-126	G	D	S	-	-	-	-	-	Bulk
2N60L-AA3-R	2N60G-AA3-R	SOT-223	G	D	S	-	-	-	-	-	Tape Reel
2N60L-TA3-T	2N60G-TA3-T	TO-220	G	D	S	-	-	-	-	-	Tube
2N60L-TF3-T	2N60G-TF3-T	TO-220F	G	D	S	-	-	-	-	-	Tube
2N60L-TF1-T	2N60G-TF1-T	TO-220F1	G	D	S	-	-	-	-	-	Tube
2N60L-TF2-T	2N60G-TF2-T	TO-220F2	G	D	S	-	-	-	-	-	Tube
2N60L-TF3T-T	2N60G-TF3T-T	TO-220F3	G	D	S	-	-	-	-	-	Tube
2N60L-TM3-T	2N60G-TM3-T	TO-251	G	D	S	-	-	-	-	-	Tube
2N60L-TMS-T	2N60G-TMS-T	TO-251S	G	D	S	-	-	-	-	-	Tube
2N60L-TMS2-T	2N60G-TMS2-T	TO-251S2	G	D	S	-	-	-	-	-	Tube
2N60L-TMS4-T	2N60G-TMS4-T	TO-251S4	G	D	S	-	-	-	-	-	Tube
2N60L-TN3-R	2N60G-TN3-R	TO-252	G	D	S	-	-	-	-	-	Tape Reel
2N60L-TND-R	2N60G-TND-R	TO-252D	G	D	S	-	-	-	-	-	Tape Reel
2N60L-K08-5060-R	2N60G-K08-5060-R	DFN5060-8	S	S	S	G	D	D	D	D	Tape Reel

Note: Pin Assignment: G: Gate D: Drain S: Source



### MARKING

PACKAGE	MARKING
TO-126	<p>UTC □□□□ → Data Code                  L: Lead Free                  G: Halogen Free                  2N60 □□□□ → Lot Code                  1</p>
SOT-223	<p>2N60 □ → L: Lead Free                  G: Halogen Free                  Lot Code ← □□ □□□□ → Data Code                  1</p>
TO-220 / TO-220F TO-220F1 / TO-220F2 TO-220F3 / TO-251 TO-251S / TO-251S2 TO-251S4 / TO-252 TO-252D	<p>UTC                  2N60 □ → L: Lead Free                  G: Halogen Free                  Lot Code ← □□□□□□□□ → Data Code                  1</p>
DFN5060-8	<p>UTC □□ → Internal Code                  2N60                  Lot Code ← • □□□□□□ → Date Code</p>

■ ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub>=25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Drain-Source Voltage		V <sub>DSS</sub>	600	V
Gate-Source Voltage		V <sub>GSS</sub>	±30	V
Avalanche Current (Note 2)		I <sub>AR</sub>	2.0	A
Drain Current	Continuous	I <sub>D</sub>	2.0	A
	Pulsed (Note 2)	I <sub>DM</sub>	8.0	A
Avalanche Energy	Single Pulsed (Note 3)	E <sub>AS</sub>	72	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	2.72	V/ns
Power Dissipation	TO-126	P <sub>D</sub>	40	W
	SOT-223		44	W
	TO-220		55	W
	TO-220F/TO-220F1		24	W
	TO-220F3			
	TO-220F2		25	W
	TO-251/TO-251S		44	W
	TO-251S2/TO-251S4			
TO-252/TO-252D				
DFN5060-8	22	W		
Junction Temperature		T <sub>J</sub>	+150	°C
Operating Temperature		T <sub>OPR</sub>	-55 ~ +150	°C
Storage Temperature		T <sub>STG</sub>	-55 ~ +150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating : Pulse width limited by T<sub>J</sub>

3. L=25mH, I<sub>AS</sub>=2.4A, V<sub>DD</sub>=50V, R<sub>G</sub>=25 Ω, Starting T<sub>J</sub> = 25°C

4. I<sub>SD</sub>≤2A, di/dt≤200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-126	θ <sub>JA</sub>	89	°C/W
	SOT-223		150	°C/W
	TO-220/TO-220F		62.5	°C/W
	TO-220F1/ TO-220F2			
	TO-220F3			
	TO-251/TO-251S		100	°C/W
	TO-251S2/TO-251S4			
	TO-252/TO-252D			
DFN5060-8	75	°C/W		
Junction to Case	TO-126	θ <sub>JC</sub>	3.12	°C/W
	SOT-223		14	°C/W
	TO-220		2.27	°C/W
	TO-220F/TO-220F1		5.2	°C/W
	TO-220F3			
	TO-220F2		5.0	°C/W
	TO-251/TO-251S		2.84	°C/W
	TO-251S2/TO-251S4			
TO-252/TO-252D				
DFN5060-8	5.68	°C/W		

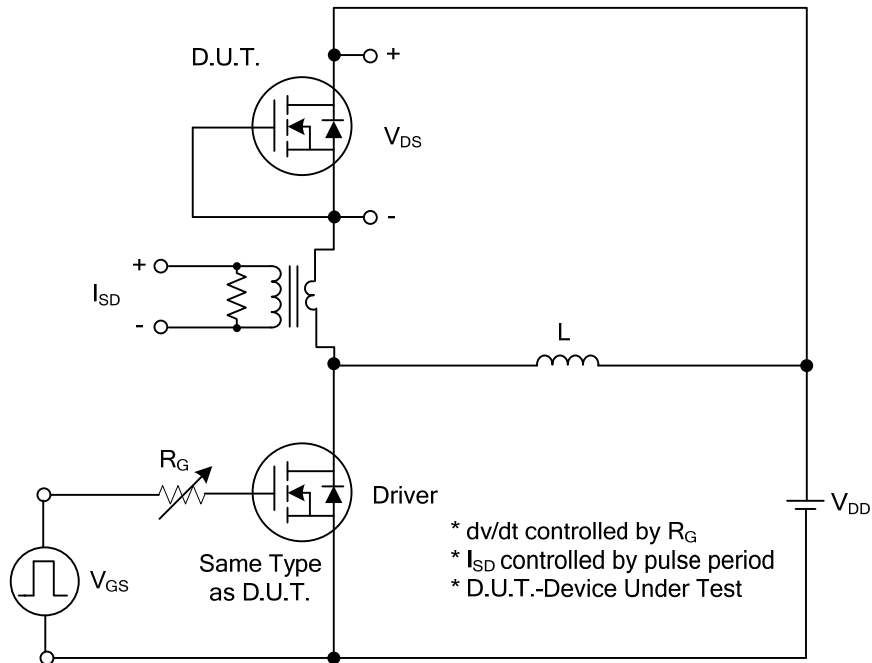
■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
<b>OFF CHARACTERISTICS</b>							
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	600			V	
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V			10	μA	
		V <sub>DS</sub> = 480V, T <sub>C</sub> = 125°C			100	μA	
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>				nA	
	Reverse						V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V
		V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V			-100	nA	
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> =250μA, Referenced to 25°C		0.4		V/°C	
<b>ON CHARACTERISTICS</b>							
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0		4.0	V	
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 1A			4.6	Ω	
<b>DYNAMIC CHARACTERISTICS</b>							
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1MHz		300		pF	
Output Capacitance	C <sub>OSS</sub>				36		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>				5		pF
<b>SWITCHING CHARACTERISTICS</b>							
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =10V, I <sub>D</sub> =1.3A, I <sub>D</sub> =100μA (Note 1, 2)		19		nC	
Gate-Source Charge	Q <sub>GS</sub>				2.3		nC
Gate-Drain Charge	Q <sub>GD</sub>				2.4		nC
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> =30V, V <sub>GS</sub> =10V, I <sub>D</sub> =0.5A, R <sub>G</sub> =25Ω (Note 1, 2)		37		ns	
Turn-On Rise Time	t <sub>R</sub>				24		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>				90		ns
Turn-Off Fall Time	t <sub>F</sub>				29		ns
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
Continuous Drain-Source Current	I <sub>SD</sub>				2	A	
Pulsed Drain-Source Current	I <sub>SM</sub>				8	A	
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	I <sub>SD</sub> =2.0 A, V <sub>GS</sub> =0 V			1.4	V	
Reverse Recovery Time	t <sub>rr</sub>	I <sub>S</sub> =2.0A, V <sub>GS</sub> = 0 V		315		ns	
Reverse Recovery Charge	Q <sub>RR</sub>	dI <sub>F</sub> /dt=100A/μs (Note1)		0.75		μC	

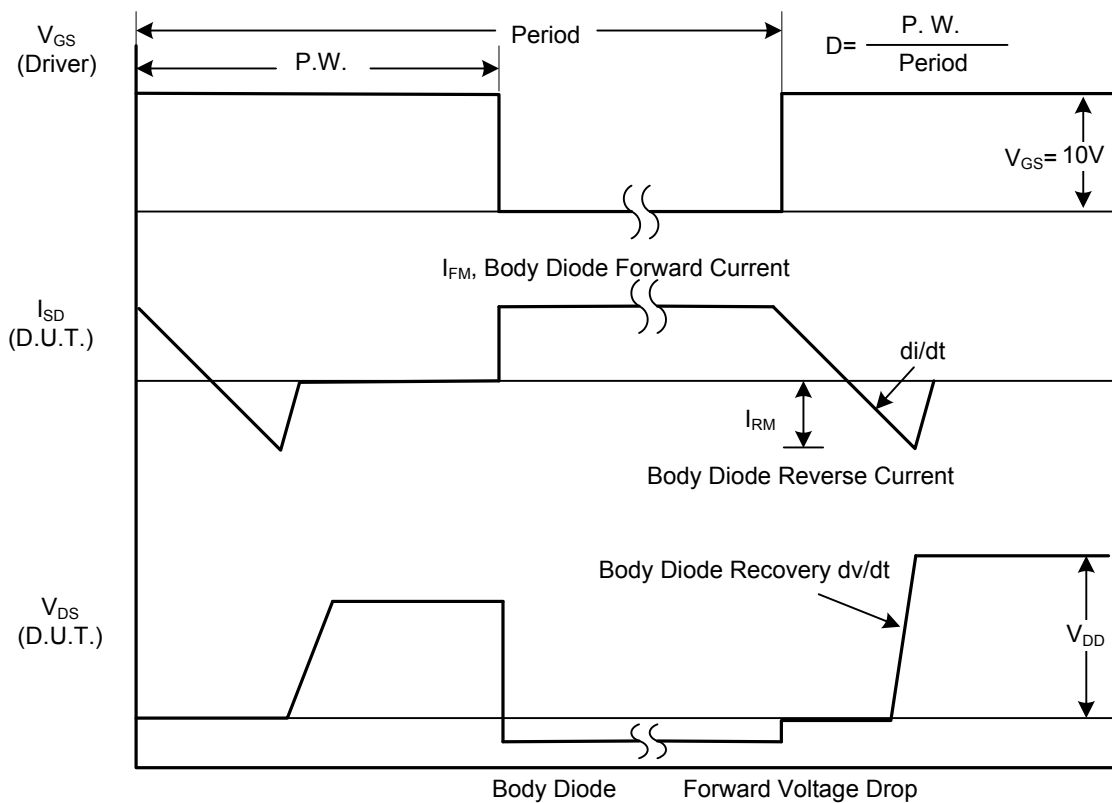
Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%.

2. Essentially independent of operating temperature.

■ TEST CIRCUITS AND WAVEFORMS

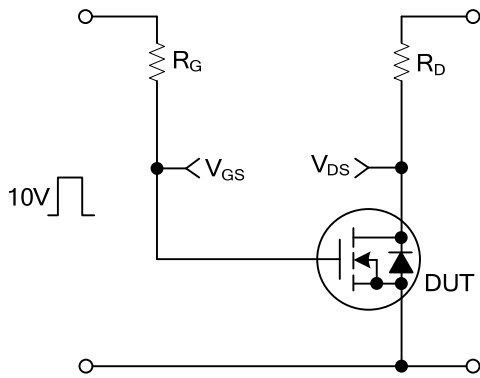


Peak Diode Recovery  $dv/dt$  Test Circuit

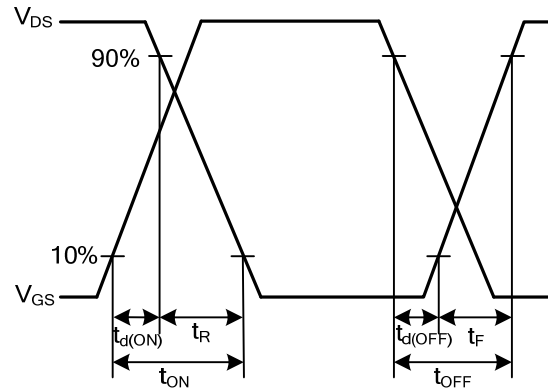


Peak Diode Recovery  $dv/dt$  Waveforms

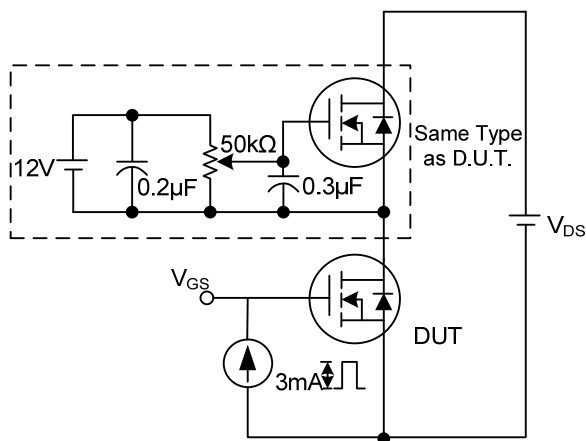
## TEST CIRCUITS AND WAVEFORMS (Cont.)



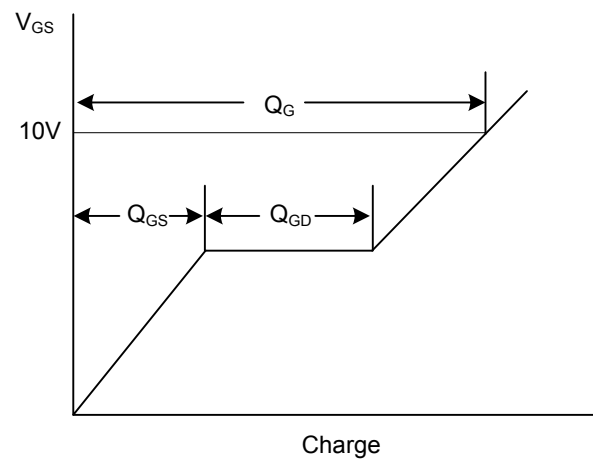
Switching Test Circuit



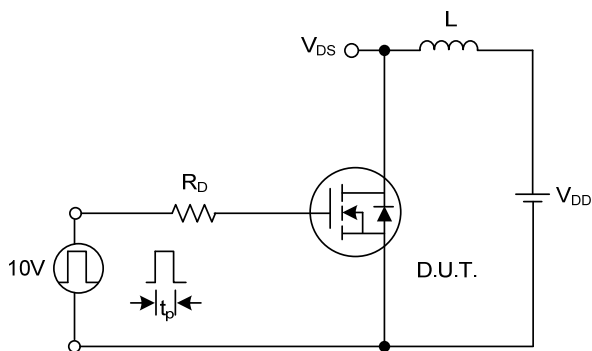
Switching Waveforms



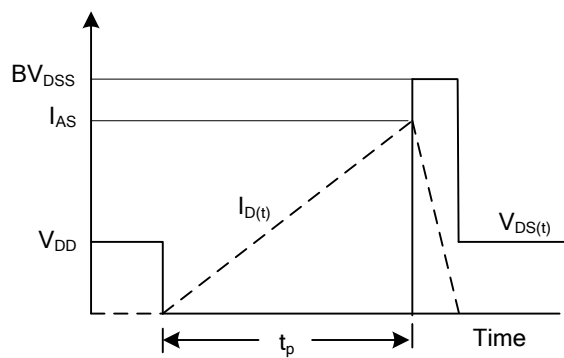
Gate Charge Test Circuit



Gate Charge Waveform

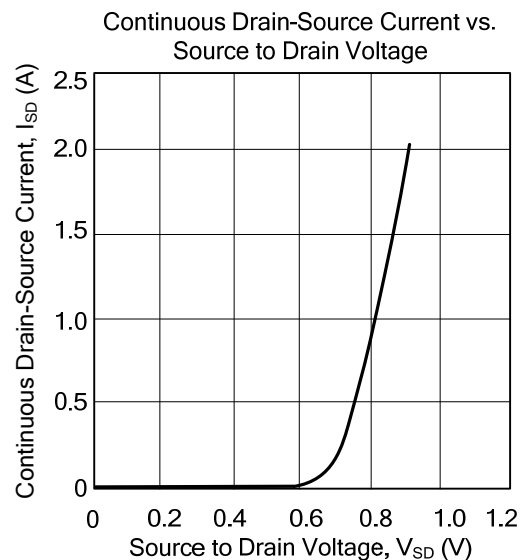
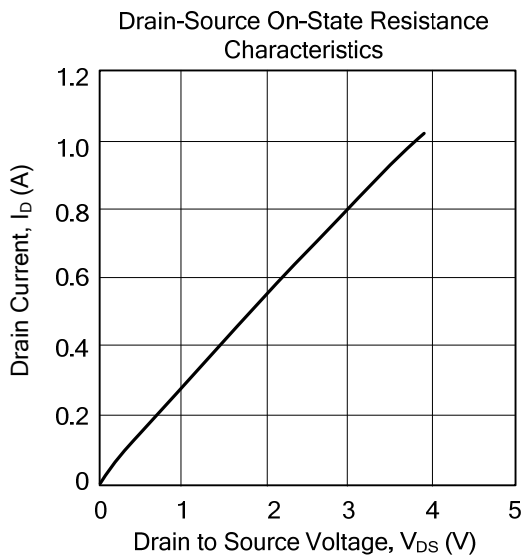
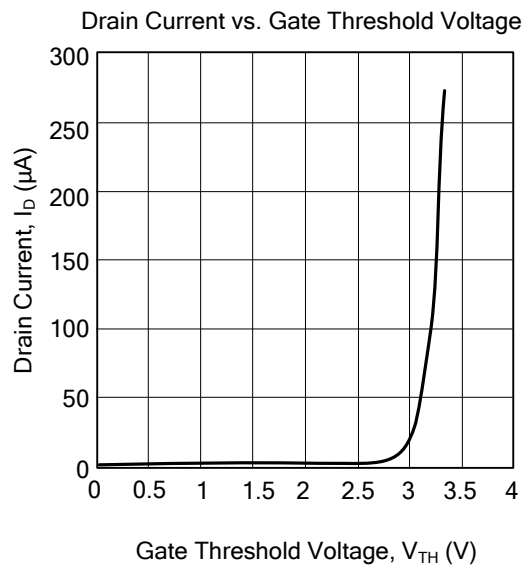
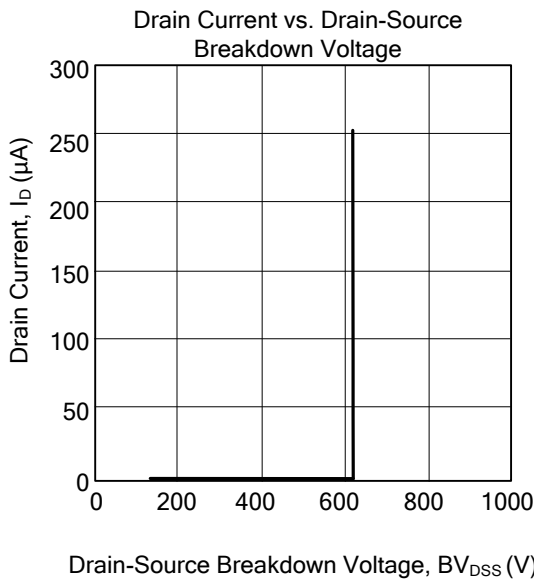


Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

### ■ TYPICAL CHARACTERISTICS



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